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Short Reports

Thoracoscopic bullectomy and tetracycline pleurodesis for the treatment of spontaneous pneumothorax

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Initial experience of thoracoscopic bullectomy and tetracycline pleurodesis for the treatment of spontaneous pneumothorax is reported. Thirty-three out of 49 patients admitted with spontaneous pneumothorax were suitable for treatment with this minimally invasive method. This series demonstrates that this surgical management offers early discharge and return to normal activities with excellent medium-term results, despite the three early failures. It is felt that with increased experience in thoracoscopy and improved selection of patients, thoracoscopic bullectomy and pleurodesis will become the treatment of choice for primary spontaneous pneumothorax.

Introduction

Primary spontaneous pneumothorax is a relatively uncommon problem having an incidence of 5–10 per 100 000 (1), but to the thoracic surgeon it represents a significant work load. The management of recurrent pneumothorax poses the problem of balance between recurrence and complications. The ideal form of management, one which results in minimal inconvenience to the patient with no complications and no recurrence, has yet to be developed.

Recurrent pneumothoraces can be managed conservatively by observation, aspiration, insertion of an intercostal chest drain or by chemical pleurodesis through the chest drain. They can be treated surgically by a wide range of procedures, those which are minimally invasive such as thoracoscopic pleurodesis and those which are not, such as thoracotomy, pleurectomy and bullous resection.

Full pleurectomy first described by Gaensler (2), although having a low recurrence rate (0·43%), as reported by Weeden and Smith (3), has a definite incidence of major complications (4,5). Major complications such as death, respiratory failure requiring ventilation and haemorrhage requiring further thoracotomy were as high as 3·7% in Weeden and Smith's series. Indeed, the complications seen after pleurectomy led Ferguson *et al.* (6) to perform bullectomy through a thoracotomy without pleurectomy. In their small series, no recurrences were observed after 3 yr follow-up suggesting that bullectomy is an important part of the procedure employed in dealing with recurrent pneumothoraces.

Pleural abrasion and bullous ligation (7,8), although associated with fewer major complications, is still recognized to cause haemothorax, pleural effusion, fibrothorax and Horner's syndrome.

With the development of medical technology and instrumentation, minimally invasive procedures are now possible. Nathansen *et al.* (9) describe the technique of thoracoscopic ligation of bullae and pleurectomy. Olsen and Andersen (10) describe thoracoscopic tetracycline pleurodesis without bullectomy, and although few complications were observed, the recurrence rate was 6%.

We describe a new minimally invasive technique which is safe, associated with few complications, has a low failure rate and to date has no recurrences.

Materials and Methods

During a 1-yr period (July 1992–June 1993), 49 patients with spontaneous pneumothoraces were admitted to Harefield Hospital, U.K. under the care of the two consultants. Of the 49 patients, 33 were considered suitable for thoracoscopic bullectomy and tetracycline pleurodesis. The remaining 16 patients were excluded for the following reasons. Seven patients were over the age of 65 years with symptoms

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and signs of chronic obstructive airways disease, and so these were classified as secondary pneumothoraces. These patients were frail with poor respiratory function and were deemed in need of an operation which would be quick and have a high success rate. These patients were treated with thoracoscopic talc pleurodesis. The remaining nine patients were all thought to be suitable for thoracoscopic tetracycline pleurodesis. At thoracoscopy, however, six patients were found to have dense adhesions and were converted to thoracotomy and underwent pleural abrasion, and three patients had large or extensive bullae requiring thoracotomy, resection of bullae and pleural abrasion.

The average age of the patients was 30 years (range 16–73 years, 28 male and 5 female). All patients had either a history of recurrent pneumothoraces or had a single pneumothorax which had failed to respond to conservative management with intercostal drainage. The mean number of episodes of pneumothorax was 2 (range 1–6 episodes of pneumothorax). Six of the 33 patients (18%) had undergone a previous operation for pneumothorax on the contralateral side. One patient had Marfan's syndrome and one patient was asthmatic. Fifty-eight percent of the patients had a history of smoking cigarettes, but none of the patients were taking steroids or anti-inflammatory drugs.

All patients were placed in the lateral position and a general anaesthetic was administered with a double lumen endotracheal tube in place. With the affected lung isolated, a 16 G needle on a 10-ml syringe was inserted into the sixth intercostal space just anterior to the spine of the scapula, and the presence of a pleural space was determined by aspiration. As a precaution, 100 ml of air was injected into the pleural space creating a sufficiently large pneumothorax to prevent damage to the lung on insertion of the cannulae. At the same site, a 10·5-mm cannula was inserted thus allowing video-assisted thoracoscopic assessment of the pleural space, and the site and extent of bullae.

If a space was present and free of adhesions, the procedure was commenced. If bullae were localized and less than 2 cm in diameter, a further two or three ports were inserted, under direct vision, thus facilitating retraction and stapling of bullae. The second entry port was in the third or fourth intercostal space in the axilla and the third port in the eighth or ninth intercostal space in the anterior axillary line. The mean number of ports employed was 3 (range 2–4 ports). Bullae were stapled using an endo GIA with a 30 or 60 mm stapling device. Using compressed air through a Clerf's cocaine spray, a solution of 20 ml of normal saline containing 1 g of tetracycline and 20 ml of 1% lignocaine was sprayed under visualization throughout the pleural cavity.

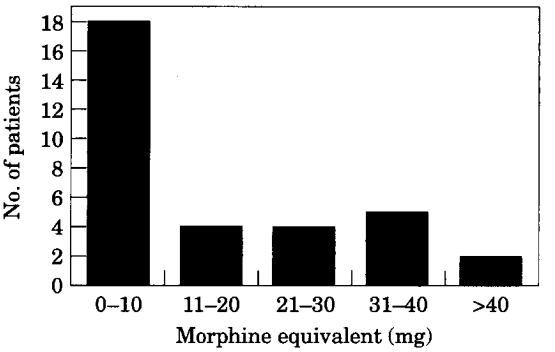

Fig. 1 Frequency histogram of morphine equivalents used for analgesia post-operatively.

One 24 F chest drain was then inserted through the most anterior entry site and positioned apically under visualization. The lung was reinflated allowing maximal area of apposition between visceral and parietal pleurae and the chest drains were connected immediately to a suction apparatus exerting a negative pressure of 5 cm H_2O. Post-operative analgesia was implemented on an 'as-required' opiate basis (Fig. 1), and anti-inflammatory drugs were avoided. The mean follow up was 18·5 months.

Results

In 31 of the 33 patients, bullae were identified at thoracoscopy and all were apical in position. Twenty-nine patients underwent thoracoscopic apical bullectomy; in two cases the bullae were very small and were not resected. The mean number of staples used to perform the bullectomy was 2·7 (range 1–6 staples). The mean length of the procedure was 54 min (range 30–95 min). One patient required conversion to thoracotomy for bleeding from the bullectomy staple line and was excluded from follow-up.

Of the remaining 32 patients, 29 (91%) patients underwent a successful thoracoscopic bullectomy and tetracycline pleurodesis with no recurrences at follow-up. In three patients, the procedure failed (9%). One patient had a persistent airleak and underwent thoracotomy, apical pleurectomy and pleural abrasion 12 days after the original operation. This patient had a pneumothorax present for 1 month at the time of thoracoscopy. The other two patients had residual pneumothoraces on discharge and were both readmitted 1 week later with progression of the pneumothorax. Both of these patients underwent

thoracotomy and pleural abrasion with one patient requiring additional stapling of a 'missed' bulla.

For the 32 patients in the study group, the chest drains were *in situ* for a mean of 4 days (range 1–20 days), but excluding the three failures, the mean was 3 days (range 1–10 days). The mean hospital stay, measured in post-operative days, was 5·3 (range 2–24 days) or excluding the three failures, 3·7 days (range 2–11 days). The mean post-operative blood loss for those treated successfully was 158 ml (range 0–750 ml) compared to 458 ml for the three patients for whom the procedure failed.

The mean cumulative post-operative analgesia requirement measured in morphine equivalents was 19 mg (range 0– 90 mg), six patients (19%) requiring no opiate analgesia (Fig. 1).

Of the three patients for whom the procedure failed, all required further treatment within 30 days of their original operation. There have been no recurrences beyond 30 days at follow-up to date (mean follow up of 18·5 months). There were no deaths and only one patient developed both a chest infection and acute retention of urine requiring catheterization. This was one of the three patients who later required thoracotomy and pleural abrasion; he was also the oldest of the group (73 years). There were no other complications.

Comment

Successful thoracoscopic tetracycline pleurodesis is dependent upon careful patient selection. It is a technique better tolerated by young patients with primary spontaneous pneumothoraces and localized bullae, and not in those secondary to diseases such as chronic obstructive airways disease in which the bullae are often adherent, large and widespread (11). These patients also tolerate single lung ventilation poorly as their respiratory reserve is often low. Indeed, two of the three patients were significantly older than the average age of the study group (43 and 73 years). The cause of failure in the 43-year-old patient was a 'missed' bulla due to more diffuse disease. This patient, in retrospect, fell into a different group.

The third failure was a patient with a chronic pneumothorax which had been present for 1 month prior to thoracoscopy and as a result of this initial experience, it is now considered that this be a contraindication to this type of surgery. As complete re-expansion of the lung is prerequisite for success after thoracoscopic tetracycline pleurodesis, it is suggested that a pneumothorax present for greater than 2 weeks should not be treated with this method.

For this procedure to be carried out safely, a pleural space should be either present or created at the time of surgery. If this is not the case or if dense adhesions are encountered, the thoracoscopic procedure should be abandoned and an open procedure employed.

It is believed that the irritant but safe qualities of tetracycline when combined with stapling through the thoracoscope provides a safe, effective and minimally invasive technique for treating patients with acute primary spontaneous pneumothoraces. Tetracycline has been the sclerosing agent of choice (12,13) when used in this group of young patients, as it is sufficiently irritant but does not have the potentially hazardous properties of talc which is frequently used in the elderly (14,15). However, it is believed that if tetracycline is to be used successfully for pleurodesis, it must be dispersed over the whole of the pleural surface under direct visualization, and that the maximum apposition of the pleurae be encouraged by suction on the drains immediately. It may well be that the lung in a chronic pneumothorax may not expand well and early enough during the maximal inflammatory reaction for effective pleurodesis. Equally important is the careful identification and stapling of all bullae as residual bullae can result in failure of this procedure. The use of anti-inflammatory drugs both pre- and post-operatively should also be avoided as maximal inflammatory reaction is desirable.

The post-operative analgesic requirements of the patients in this study was a mean of 19 mg morphine or its equivalent, and indeed six patients required no opiates. It is believed that early mobilization of the patients will result in fewer post-operative complications such as chest infections, deep vein thrombosis and pulmonary embolism. The use of 1% lignocaine instilled into the pleural cavity at the time of the pleurodesis is recommended, in order to reduce early post-operative pain (16).

In those patients for whom the procedure was successful, the chest drain was *in situ* for a mean of 3 days with a post-operative stay of 4 days, which is probably similar to those patients treated by a conventional thoracotomy and pleural abrasion. However, the patients treated successfully by this minimally invasive procedure returned to their normal activities/work, after 1 month (on average, Fig. 2). At follow-up, there have been no recurrences beyond 30 days post-operation.

Conclusions

Thoracoscopic bullectomy combined with tetracycline pleurodesis is believed to be a safe and effective,

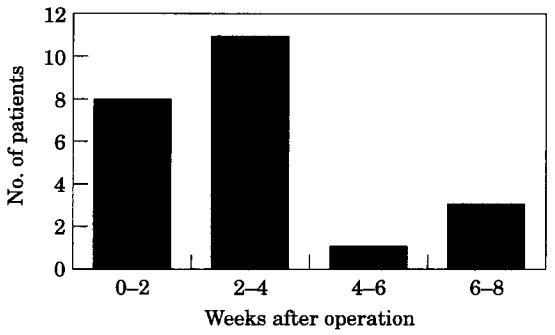

Fig. 2 Frequency histogram of the time required to return to work/normal activities after operation.

minimally invasive alternative for the treatment of primary spontaneous pneumothorax. It is a relatively painless procedure with few post-operative complications and a rapid rehabilitation and return to work. There is clearly a need for a prospective, randomized, controlled clinical trial to rigorously test the efficacy of this procedure. As experience with thoracoscopy increases and the learning curve is mastered, it is believed that thoracoscopic bullectomy and pleurodesis will become the treatment of choice for spontaneous pneumothorax in the near future. Careful patient selection is essential in order to minimize the early failure rate.

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